RECOGNITION AND MANAGEMENT
OF AGENTS OF BIOTHREATS AND HIGHLY
COMMUNICABLE INFECTIONS

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TERRORISM TODAY

New York, September 11, 2001

Time, Special Edition
LECTURE TOPICS

- Potential exposures to rare and exotic diseases
- Major biologic warfare agents
- For most likely BW agents (anthrax, smallpox): Pre-exposure prophylaxis, post-exposure prophylaxis, therapy
- Recognizing a biologic warfare attack
- Review of anthrax and smallpox
EMERGING INFECTIOUS DISEASES: DEFINITION

- Emerging infectious diseases can be defined as infections that have newly appeared in the population, or have existed but are rapidly increasing in incidence or geographic range.
SOURCES OF EXOTIC DISEASES

- Travel
- Animal exposure (zoonotic diseases)
  - Exposure via travel, leisure pursuits (hunting, camping, fishing), occupation (farming), pets
- Bioterrorist agents
- Research
  - Exposure via laboratory work or animal care
Speed of Global Travel in Relation to World Population Growth

From: Murphy and Nathanson Sems. Virol. 5, 87, 1994
**VISITORS TO THE US, 2013**

<table>
<thead>
<tr>
<th>Country</th>
<th>Visitors (millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canada</td>
<td>23.4</td>
</tr>
<tr>
<td>Mexico</td>
<td>14.3</td>
</tr>
<tr>
<td>UK</td>
<td>3.8</td>
</tr>
<tr>
<td>Japan</td>
<td>3.7</td>
</tr>
<tr>
<td>Brazil</td>
<td>2.1</td>
</tr>
<tr>
<td>Germany</td>
<td>1.9</td>
</tr>
<tr>
<td>China</td>
<td>1.8</td>
</tr>
<tr>
<td>France</td>
<td>1.5</td>
</tr>
<tr>
<td>S. Korea</td>
<td>1.4</td>
</tr>
<tr>
<td>Australia</td>
<td>1.2</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>69.8</strong></td>
</tr>
</tbody>
</table>

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**Share of Global Arrivals (1995-2013)**

- **Advanced Economies**
- **Emerging Economies**

- **Spending (lhs)**
- **Visitors (rhs)**

*Source: Tinet.ita.doc.gov/outreachpages/download_data_table/Fast_Facts.pdf*
FACTORS INFLUENCING NEW AND REEMERGING ZOONOSES

- Climate change influencing arthropods
- Translocation of infected animals or persons
- Tourism
- Changes in land use
- Pathogen adaptation to new host species
- Acquisition of new virulence traits
- Alteration in livestock management practices
- Companion animals
- Exotic foods (bush meat)
- Exotic pets

Infection of humans or animals

EXAMPLES OF ROUTES BY WHICH ZOONOSES ARE ACQUIRED

- Direct contact
  - Dermatophytes
  - Tularemia

- Contact with animal products
  - Anthrax

- Contact with urine
  - Leptospirosis

- Fecal–oral route
  - Salmonellosis

- Bites and scratches
  - Rabies

- Via ectoparasites carrying pathogens
  - Ticks: Rocky Mountain spotted fever, tularemia, Lyme disease, babesiosis, fleas: plague

- Eating undercooked meat, fish
  - Trichinellosis
  - Toxoplasmosis
  - Taenia solium

- Ingestion of milk
  - Mycobacterium bovis
  - Histoplasmosis

- Respiratory route

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OUTBREAKS AND EPIDEMICS IN AFRICA, WHO, 1970-2016

Figure 1 A graph of all the outbreak and epidemic events by disease in the countries of the WHO African region.
Emerging Pathogens

Since ~1950, accelerating pattern

>300 Emerging Pathogens

Developments facilitating spread
- Commercial air travel
- Global trade
- Urbanization
- Unchecked population growth
- Climate change

Advances facilitating control
- Genome sequencing to identify emerging viruses
- Global communication networks
- Rapid diagnostics
- New approaches to vaccine and therapeutic design
FIGURE 1. Chain of transmission among guests at Hotel M — Hong Kong, 2003

1 Health-care workers.
2 All guests except G and K stayed on the 9th floor of the hotel. Guest G stayed on the 14th floor, and Guest K stayed on the 11th floor.
3 Guests L and M (spouses) were not at Hotel M during the same time as index Guest A but were at the hotel during the same times as Guests G, H, and I, who were ill during this period.
## Emerging Diseases in the US

<table>
<thead>
<tr>
<th>Disease (Source)</th>
<th>Cases</th>
<th>Outcome</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>West Nile virus (Israel)</td>
<td>Thousands</td>
<td>Endemic (US)</td>
<td>1999</td>
</tr>
<tr>
<td>SARS (China)</td>
<td>8096 (8 US, 1 UNC)</td>
<td>Controlled</td>
<td>2003</td>
</tr>
<tr>
<td>Monkeypox (Africa)</td>
<td>71</td>
<td>Controlled</td>
<td>2003</td>
</tr>
<tr>
<td>Novel flu, H1N1 (Mexico)</td>
<td>Thousands</td>
<td>Endemic (Worldwide)</td>
<td>2009</td>
</tr>
<tr>
<td>MERS-CoV (Arabian Peninsula)</td>
<td>Hundreds</td>
<td>Epidemic (Arabian area)</td>
<td>2014</td>
</tr>
<tr>
<td>Enterovirus D68</td>
<td>Hundreds (13 UNC)</td>
<td>Epidemic (US)</td>
<td>2014</td>
</tr>
<tr>
<td>Ebola</td>
<td>Thousands (1 US)</td>
<td>Epidemic (West Africa)</td>
<td>2014-15</td>
</tr>
</tbody>
</table>
WHO LIST OF PRIORITY DISEASES, 2015

- Arenaviral hemorrhagic fevers (including Lassa Fever)
- Crimean Congo Haemorrhagic Fever (CCHF)
- Filoviral diseases (including Ebola and Marburg)
- Middle East Respiratory Syndrome Coronavirus (MERS-CoV)
- Other highly pathogenic coronaviral diseases (such as Severe Acute Respiratory Syndrome, (SARS))
- Nipah and related henipaviral diseases
- Rift Valley Fever (RVF)
- Severe Fever with Thrombocytopenia Syndrome (SFTS)
- Zika
UNC HOSPITAL PREPAREDNESS:
HIGHLY COMMUNICABLE DISEASES

● Critical issues
  ■ Surge capacity
  ■ Maintaining adequate staffing
  ■ Provision of essential services/supplies

● Additional issues
  ■ Surveillance
  ■ Diagnosis
  ■ Protecting personnel
  ■ Occupational health
  ■ Stockpiling PPE
  ■ Triage of limited supplies/beds
  ■ Security
SPECIAL AIRBORNE/CONTACT PRECAUTIONS

- New outpatient clinic constructed to see patients with highly contagious diseases
  - Direct entry from outside
  - All rooms have airborne isolation
- Representative pathogens
  - Monkeypox
  - SARS Co-V
  - Smallpox
  - Ebola
Emerging infectious diseases: Focus on infection control issues for novel coronaviruses (Severe Acute Respiratory Syndrome-CoV and Middle East Respiratory Syndrome-CoV), hemorrhagic fever viruses (Lassa and Ebola), and highly pathogenic avian influenza viruses, A(H5N1) and A(H7N9)

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b Division of Infectious Diseases, University of North Carolina School of Medicine, Chapel Hill, NC
c Division of Pulmonary and Critical Care Medicine, University of North Carolina School of Medicine, Chapel Hill, NC
### Selected emerging diseases of infection control importance

<table>
<thead>
<tr>
<th>Disease (initial location)</th>
<th>Cases (United States)</th>
<th>Outcome</th>
<th>Person-to-person transmission</th>
<th>Patient-to-HCP transmission</th>
<th>Infection control risk</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Legionnaires’ disease</td>
<td>Unknown (thousands)</td>
<td>Endemic and epidemic</td>
<td>No</td>
<td>No</td>
<td>High</td>
<td>1976-present</td>
</tr>
<tr>
<td>HIV (Africa)</td>
<td>Millions (thousands)</td>
<td>Ongoing epidemic</td>
<td>Yes (blood exposure, organ transplantation, vertical, sexual)</td>
<td>Yes (blood exposure)</td>
<td>Moderate</td>
<td>1978-present</td>
</tr>
<tr>
<td>vcJD</td>
<td>Hundreds</td>
<td>Controlled</td>
<td>Yes (blood, theoretically via contaminated medical instruments)</td>
<td>No</td>
<td>Low</td>
<td>1996</td>
</tr>
<tr>
<td>West Nile fever</td>
<td>(Thousands)</td>
<td>Endemic</td>
<td>Yes (blood transfusions, vertical, organ transplantation)</td>
<td>No</td>
<td>Low</td>
<td>1999</td>
</tr>
<tr>
<td>SARS (China)</td>
<td>~8,000 (8)</td>
<td>Controlled</td>
<td>Yes (droplet, contact, airborne?)</td>
<td>Yes</td>
<td>High</td>
<td>2003-2004</td>
</tr>
<tr>
<td>Monkeypox (Africa)</td>
<td>(37 confirmed, 10 probable)</td>
<td>Eliminated in United States</td>
<td>Yes (droplet, contact)</td>
<td>Yes</td>
<td>High</td>
<td>2003</td>
</tr>
<tr>
<td>MERS (Middle East)</td>
<td>Thousands (2)</td>
<td>Controlled</td>
<td>Yes (droplet, contact)</td>
<td>Yes</td>
<td>High</td>
<td>2014-present</td>
</tr>
<tr>
<td>Ebola (West Africa)</td>
<td>Thousands (4)</td>
<td>Controlled United States, reduced Africa</td>
<td>Yes (contact, sexual)</td>
<td>Yes</td>
<td>High</td>
<td>2014-present</td>
</tr>
</tbody>
</table>

HCP, health care personnel; MERS, Middle East respiratory syndrome; SARS, severe acute respiratory syndrome; vcJD, variant Creutzfeldt-Jakob disease.

*Infection via a needlestick theoretically possible.

†No HCP developed infection during the U.S. outbreak but patient-to-HCP transmission described in Africa.
<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Lassa fever</th>
<th>Ebola virus disease</th>
<th>MERS</th>
<th>SARS</th>
<th>Novel influenza A</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Virus</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Year identified</td>
<td>1969</td>
<td>1976</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Family</td>
<td>Arenaviridae</td>
<td>Filoviridae</td>
<td></td>
<td></td>
<td>Orthomyxovirida</td>
</tr>
<tr>
<td>Genome</td>
<td>RNA</td>
<td>RNA</td>
<td>RNA</td>
<td>RNA</td>
<td></td>
</tr>
<tr>
<td>Coat</td>
<td>Enveloped</td>
<td>Enveloped</td>
<td>Enveloped</td>
<td>Enveloped</td>
<td>Enveloped</td>
</tr>
<tr>
<td><strong>Epidemiology</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Endemic location</td>
<td>West Africa</td>
<td>West and Central Africa</td>
<td>Middle East</td>
<td>China</td>
<td>Worldwide (location varies with strain)</td>
</tr>
<tr>
<td>Prevalence</td>
<td>100,000-300,000 cases per year</td>
<td></td>
<td>No recent human cases</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reservoir</td>
<td>Rodent (rat)</td>
<td>Bats (fruit)</td>
<td>Bats, camels (intermediate host)</td>
<td>Bats, palm civet</td>
<td>Migratory birds, pigs</td>
</tr>
<tr>
<td>Transmission</td>
<td>Inhalation, ingestion, contact (nonintact skin)</td>
<td>Contact (nonintact skin, mucous membranes, sexual)</td>
<td>Droplet, contact, airborne</td>
<td>Inhalation, contact</td>
<td></td>
</tr>
<tr>
<td>Incubation period (d)</td>
<td>10 (range, 6-21)</td>
<td>6-12 (range, 2-21)</td>
<td>2-15</td>
<td>2-14 (range, 2-21)</td>
<td>Varies by strain</td>
</tr>
<tr>
<td>Infectivity, Rho (not determined)</td>
<td>Not determined</td>
<td>1.5-2.0</td>
<td>0.3-1.3</td>
<td>2.2-3.7 (range, 0.3-4.1)</td>
<td>Varies by strain</td>
</tr>
<tr>
<td>Duration, maximum (d)</td>
<td>28</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Case fatality rate (%)</td>
<td>15%-20%, hospitalized patients</td>
<td>~50% (range, 25%-90%)</td>
<td>&gt;35%</td>
<td>~10%</td>
<td></td>
</tr>
<tr>
<td><strong>Biologic safety</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biothreat level</td>
<td>A</td>
<td>A</td>
<td>Not specified</td>
<td>C</td>
<td>C (some strains)</td>
</tr>
<tr>
<td>Biosafety level</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>2-3</td>
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<tr>
<td><strong>Clinical</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Therapy</td>
<td>Ribavirin</td>
<td>Supportive</td>
<td>Supportive</td>
<td>Supportive</td>
<td>Supportive</td>
</tr>
<tr>
<td>Neuraminidase inhibitors</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Infection control</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isolation</td>
<td>Contact, droplet, airborne for aerosol-generating procedures</td>
<td>Contact, droplet, airborne for aerosol-generating procedures</td>
<td>Contact, airborne</td>
<td>Contact, airborne</td>
<td>Droplet, airborne for aerosol-generating procedures</td>
</tr>
<tr>
<td>Pre-exposure prophylaxis, vaccine</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes (some strains)</td>
</tr>
<tr>
<td>Postexposure prophylaxis</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes (antivirals)</td>
</tr>
</tbody>
</table>
BILOGIC WARFARE: HISTORY

- 300 BC: Greeks pollute wells and drinking water with animal corpses
- 1346, Kaffa: Attacking Tatar force catapulted cadavers of plague victims into city – outbreak of plague led to defeat
- 1763, Fort Pitt, North America: Blankets from smallpox hospital provided to Native Americans – resulted in epidemic of smallpox among tribes in Ohio River valley
- 1932-45, Manchuria: Japanese military physicians infected 10,000 prisoners with biological agents (B. anthracis, Y. pestis, V. cholerae, Salmonella spp., Shigella spp.) – 11 Chinese cities attacked via food/water contamination, spraying via aircraft
Attack in Northern Iraq by former Government using nerve and mustard gas

Sarin gas attack in Tokyo subway
USE OF BIOLOGICAL AGENTS: US

- Site: The Dalles, Oregon, 1984
- Agent: *Salmonella typhimurium*
- Method of transmission: Restaurant salad bars
- Number ill: 751 (45 hospitalized)
- Responsible party: Members of a religious community had deliberately contaminated the salad bars on multiple occasions (goal to incapacitate voters to prevent them from voting and thus influence the outcome of the election)

Oregon, 1984. For months, the free-love commune of guru Bhagwan Shree Rajneesh had been at odds with its neighbors. As a critical town vote neared over land use affecting the cult, two members cultured salmonella in a secret lab. They dumped the bacteria into salad bars and coffee creamers at 10 restaurants. Supermarket produce was also contaminated, and plans were made to poison the city water supply. At least 751 people fell ill. It took investigators a year to link the attack to the sect. Two cult members pleaded guilty to conspiring to tamper with consumer products.
USE OF BIOLOGICAL AGENTS: US

- Site: Large medical center, Texas, 1997
- Agent: *Shigella dysenteriae*
- Method of transmission: Ingestion of muffins/doughnuts
- Number ill: 45 (4 hospitalized)
- Responsible party: Disgruntled lab employee? *S. dysenteriae* identical by PFGE from stock culture stored in laboratory

BIOTERRORISM: WHY NOW?

- SecDef William Cohen, March 1998, Heritage Foundation
  - Our American military superiority presents a paradox... because our potential adversaries know they can’t win in a conventional challenge to the U.S. forces, they’re much more likely to try unconventional or asymmetrical methods, such as biologic or chemical weapons

- Richard Betts, Council on Foreign Relations
  - Nuclear arms have great killing capacity but are hard to get; chemical weapons are easy to get but lack such killing capacity; biological agents have both qualities.
TRENDS FAVORING BIOLOGICAL WEAPONS

- Biological weapons have an unmatched destructive potential
- Technology for dispersing biologic agents is becoming more sophisticated
- The lag time between infection and appearance of symptoms generally is longer for biological agents than with chemical exposures
- Lethal biological agents can be produced easily and cheaply
- Biological agents are easier to produce clandestinely than are either chemical or nuclear weapons

Heritage Foundation
TRENDS FAVORING BIOLOGICAL WEAPONS

- Global transportation links facilitate the potential for biological terrorist strikes to inflict mass casualties
- Urbanization provides terrorists with a wide array of lucrative targets
- The Diaspora of Russian scientists has increased the danger that rogue states or terrorist groups will accrue the biological expertise needed to mount catastrophic terrorist attacks
- The emergence of global, real-time media coverage increases the likelihood that a major biological incident will induce panic
Figure 1: Stages and Obstacles for Chemical and Biological Terrorism

1. Possess requisite technical skills
2. Acquire basic chemicals or infective biological seed cultures
3. Synthesize chemical agents or grow biological agents (unnecessary for toxic industrial chemicals)
4. Process the chemical or biological agents into a form that can be effectively delivered (unnecessary for some chemical agents)
5. Improvise an agent delivery device
6. Release chemical or biological agents to cause mass casualties
7. Conduct testing procedures
8. Avoid detection by authorities
9. Recognize environmental and meteorological conditions

Source: GAO, on the basis of analysis of technical data and discussions with chemical and biological warfare experts.
Centers for Disease Control

Bioterrorist Agents: Category A

- Easily disseminated or transmitted person-to-person
- High mortality, with potential for major public health impact
- Might cause public panic and social disruption
- Require special action for public health preparedness

- Viruses: Variola major (smallpox), filoviruses (e.g., Ebola, Marburg), arenaviruses (e.g., Lassa, Machupo)
- Bacteria: Bacillus anthracis (anthrax), Yersinia pestis (plague), Francisella tularensis (tularemia)
- Toxins: Clostridium botulinum toxin (botulism)

http://emergency.cdc.gov/agent/agentlist-category.asp
CENTERS FOR DISEASE CONTROL
BIOTERRORIST AGENTS: CATEGORY B

- Moderately easy to disseminate
- Moderate morbidity and low mortality
- Require improved diagnostic capacity & enhanced surveillance.
- **Viruses**: Alphaviruses (VEE, EEE, WEE)
- **Bacteria**: *Coxiella burnetii* (Q fever), *Brucella* spp. (brucellosis), *Burkholderia mallei* (glanders), *B. pseudomallei* (melioidosis), *Rickettsia prowazekii* (typhus fever), *Chlamydia psittaci* (psittacosis)
- **Toxins**: *Rinus communis* (caster beans) ricin toxin, *Clostridium perfringens* episolon toxin, *Staphylococcus enterotoxin B*
- **Food/waterborne pathogens**: *Salmonella* spp., *Vibrio cholerae*, *Shigella dysenteriae*, *E. coli* O157:H7, *Cryptosporidium parvum*, etc.
CENTERS FOR DISEASE CONTROL
BIOTERRORIST AGENTS: CATEGORY C

- Availability
- Ease of production and dissemination
- Potential for high morbidity and mortality and major public health impact
- Emerging agents such as Nipah virus and hantavirus
CDC FACT SHEETS AVAILABILITY

- Anthrax
- Botulism
- Brucellosis
- Plague
- Smallpox
- Tularemia
- Viral hemorrhagic fevers

http://emergency.cdc.gov/bioterrorism/factsheets.asp
CHARACTERISTICS* OF PRIORITY AGENTS

- Infectious via aerosol
- Organisms fairly stable in aerosol
- Susceptible civilian populations
- High morbidity and mortality
- Person-to-person transmission
- Difficult to diagnose and/or treat
- Previous development for BW

* Priority agents may exhibit all or some of the above characteristics
## Sample Biological Agent Ratings

<table>
<thead>
<tr>
<th>Disease</th>
<th>Public Health Impact</th>
<th>Dissemination Potential</th>
<th>Special Preparedness</th>
<th>Public Perception</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Morbidity</td>
<td>Mortality</td>
<td>Stable/Produce/Distribute</td>
<td>Transmissible</td>
</tr>
<tr>
<td>Smallpox</td>
<td>+</td>
<td>++</td>
<td>++</td>
<td>+++</td>
</tr>
<tr>
<td>Inhalational anthrax</td>
<td>++</td>
<td>+++</td>
<td>+++</td>
<td>-</td>
</tr>
<tr>
<td>Pneumonic plague</td>
<td>++</td>
<td>+++</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>Tularemia</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>-</td>
</tr>
<tr>
<td>Botulism</td>
<td>++</td>
<td>+++</td>
<td>++</td>
<td>-</td>
</tr>
<tr>
<td>VHF</td>
<td>++</td>
<td>+++</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Glanders</td>
<td>++</td>
<td>+++</td>
<td>++</td>
<td>-</td>
</tr>
<tr>
<td>VE</td>
<td>++</td>
<td>+</td>
<td>++</td>
<td>-</td>
</tr>
<tr>
<td>Q fever</td>
<td>+</td>
<td>+</td>
<td>++</td>
<td>-</td>
</tr>
<tr>
<td>Brucellosis</td>
<td>+</td>
<td>+</td>
<td>++</td>
<td>-</td>
</tr>
<tr>
<td>Toxins</td>
<td>++</td>
<td>++</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>HPS</td>
<td>++</td>
<td>++</td>
<td>+</td>
<td>++</td>
</tr>
<tr>
<td>Nipah encephalitis</td>
<td>++</td>
<td>++</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
SOURCES OF BIOTERRORISM

- Biological warfare
- State sponsored terrorism
- International terrorist groups
- National cults
- The deranged “Ioner”
government try capital defend-
deterioration,
Attorney decided to
convicted that "product of ill
life. I must
If the de-
ingen for me,"
ment's de-
position to
s.
ly the
be true
I fol-
stitute

TIM ROSKE—POOL/ AP
The Next Unabomber

As accused murderer Theodore Kaczynski goes on trial, the FBI is investigating more than 50 cases of terrorists suspected of plotting attacks here. Their tools are easy-to-make chemical and biological weapons.
BIOTERRORISM: IMPACT

- Direct infection: Mortality, morbidity
- Indirect infection: Person-to-person transmission, fomite transmission
- Environmental impact: Environmental survival, animal infection
- Other: Social, political, economic
EFFECTS OF A NUCLEAR WEAPONS RELEASE

Casualties from Nuclear Release
(Either a small (10 kiloton) bomb or destruction of a nuclear reactor)

Prompt Effects
- 98% Dead
- 50% Dead
- Incapacitated
- Irritant
- Primarily Ecological Effects

Siegrist, Emerging Infectious Diseases 1999
EFFECTS OF A BIOLOGICAL WEAPONS RELEASE

Casualties from Biological Weapons Release

(10kg viable Anthrax) Maximum Value=0.00657

% Fatality

76+
50+
24+
8+
2+

Source: Robert M. Cox, NDU and Richard Fry, DIO

Siegrist, Emerging Infectious Diseases 1999
BIOLOGICAL WARFARE: IMPACT

[release of 50 kg agent by aircraft along a 2 km line upwind of a population center of 500,000 – Christopher et al., JAMA 278;1997:412]

<table>
<thead>
<tr>
<th>Agent</th>
<th>Downwind reach, km</th>
<th>No. dead</th>
<th>No. incapacitated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rift Valley fever</td>
<td>1</td>
<td>400</td>
<td>35,000</td>
</tr>
<tr>
<td>Tick-borne encephalitis</td>
<td>1</td>
<td>9,500</td>
<td>35,000</td>
</tr>
<tr>
<td>Typhus</td>
<td>5</td>
<td>19,000</td>
<td>85,000</td>
</tr>
<tr>
<td>Brucellosis</td>
<td>10</td>
<td>500</td>
<td>125,000</td>
</tr>
<tr>
<td>Q fever</td>
<td>&gt;20</td>
<td>150</td>
<td>125,000</td>
</tr>
<tr>
<td>Tularemia</td>
<td>&gt;20</td>
<td>30,000</td>
<td>125,000</td>
</tr>
<tr>
<td>Anthrax</td>
<td>&gt;20</td>
<td>95,000</td>
<td>125,000</td>
</tr>
</tbody>
</table>
CHARACTERISTICS OF BIOWARFARE

- Potential for massive numbers of casualties
- Ability to produce lengthy illnesses requiring prolonged and intensive care
- Ability of certain agents to spread via contagion
- Paucity of adequate detection systems
- Presence of an incubation period, enabling victims to disperse widely
- Ability to produce non-specific symptoms, complicating diagnosis
- Ability to mimic endemic infectious diseases, further complicating diagnosis

STEPS IN MANAGEMENT

1. Maintain an index of suspicion
2. Protect thyself
3. Assess the patient
4. Decontaminate as appropriate
5. Establish a diagnosis
6. Render prompt therapy
7. Practice good infection control
8. Alert the proper authorities
9. Assist in the epidemiologic investigation
10. Maintain proficiency and spread the gospel

<table>
<thead>
<tr>
<th>Disease</th>
<th>Incubation period (days)</th>
<th>Person-to-person transmission</th>
<th>Infection control precautions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inhalational anthrax (see Chapter 185)</td>
<td>2–43*</td>
<td>No</td>
<td>Standard</td>
</tr>
<tr>
<td>Botulism (see Chapter 25)</td>
<td>12–72 hours</td>
<td>No</td>
<td>Standard</td>
</tr>
<tr>
<td>Primary pneumonic plague (see Chapter 176)</td>
<td>1–6</td>
<td>Yes</td>
<td>Droplet</td>
</tr>
<tr>
<td>Smallpox (see Chapter 151)</td>
<td>7–17</td>
<td>Yes</td>
<td>Contact and airborne</td>
</tr>
<tr>
<td>Tularemia (see Chapter 177)</td>
<td>1–14</td>
<td>No</td>
<td>Standard</td>
</tr>
<tr>
<td>Viral hemorrhagic fevers (see Chapter 183)</td>
<td>2–21</td>
<td>Yes</td>
<td>Contact and airborne</td>
</tr>
<tr>
<td>Viral encephalitides (see Chapter 23)</td>
<td>2–14</td>
<td>No</td>
<td>Standard</td>
</tr>
<tr>
<td>Q fever (see Chapter 235)</td>
<td>2–14</td>
<td>No</td>
<td>Standard</td>
</tr>
<tr>
<td>Brucellosis (see Chapter 180)</td>
<td>5–60</td>
<td>No</td>
<td>Standard</td>
</tr>
<tr>
<td>Glanders</td>
<td>10–14</td>
<td>No</td>
<td>Standard</td>
</tr>
</tbody>
</table>

* Based on limited data from human outbreaks; experimental animal data support clinical latency periods of up to 100 days
## STAYING ALERT AND EDUCATED


<table>
<thead>
<tr>
<th>Condition</th>
<th>Contagious</th>
<th>Clinical Form or Forms</th>
<th>Vaccine Available</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anthrax</td>
<td>No</td>
<td>Three primary forms: cutaneous, inhalational, and gastrointestinal</td>
<td>Yes</td>
<td>Combination antimicrobials, effusion drainage, monoclonal antibody</td>
</tr>
<tr>
<td>Smallpox</td>
<td>Yes</td>
<td>Centrifugal rash with same-stage lesions</td>
<td>Yes</td>
<td>Supportive treatment</td>
</tr>
<tr>
<td>Plague</td>
<td>Yes</td>
<td>Pneumonic or bubonic</td>
<td>No</td>
<td>Antimicrobials</td>
</tr>
<tr>
<td>Botulism</td>
<td>No</td>
<td>Inhalational or gastrointestinal</td>
<td>No</td>
<td>Antitoxin</td>
</tr>
<tr>
<td>Tularemia</td>
<td>No</td>
<td>Inhalational or ulceroglandular</td>
<td>No</td>
<td>Antimicrobials</td>
</tr>
</tbody>
</table>
FOMITE ACQUISITION

- Agents acquired from contaminated clothes
  - Variola major (smallpox)
  - *Bacillus anthracis* (anthrax)
  - *Coxiella burnetii* (Q fever)
  - *Yersinia pestis* (plague)

- Management
  - Remove clothing, have patient shower
  - Place contaminated clothes in impervious bag, wear PPE
  - Decontaminate environmental surfaces with EPA approved germicidal agent or 0.5% bleach (1:10 dilution)
DETECTION OF OUTBREAKS

- Epidemiologic clues
- Medical clues
- Syndromic surveillance
- Other
  - Intelligence reports
  - Claims of release
  - Discovery of munitions or tampering
  - Increased numbers of pharmacy orders for antibiotics
  - Increased number of 911 calls

ID Clinics NA 2006;20:179-211
DETECTION OF BT OUTBREAKS:
EPIDEMIOLOGIC CLUES

- A rapidly increasing disease incidence
- Unusual clustering of disease for the geographic area
- Disease occurrence outside of the normal transmission season
- Simultaneous outbreaks of different infectious diseases
- Disease outbreak in humans after recognition of disease in animals
- Unexplained number dead animals or birds
- Disease requiring for transmission a vector previously not seen in the area
- Rapid emergence of genetically identical pathogens from different geographic areas
DETECTION OF BT OUTBREAKS: MEDICAL CLUES

- Unusual route of infection
- Unusual age distribution or clinical presentation of common disease
- More severe disease and higher fatality rate than expected
- Unusual variants of organisms
- Unusual antimicrobial susceptibility patterns
- Any patient presenting with a disease that is relatively uncommon and has bioterrorism potential
THE PROBLEM OF NEEDLES IN HAYSTACKS

- Outbreak severe acute respiratory infections
  - MERS, SARS, H5N1, H7N9, HxNy…

- Viral hemorrhagic fevers (VHF)
  - Ebola, Marburg, Lassa fever, Rift Valley, CCHF, bunyavirus

- Intentional release
  - Anthrax, smallpox, ricin

- Naturally occurring severe infections
  - Bacterial: Plague, tularemia, melioidosis
  - Viral: Adenovirus, parainfluenza, RSV
DEVELOPING A BT PLAN

- Recognition of infection
- Incident command system
- Communication with public health
- Triage of patients
- Decontamination of patients
- Maintaining clean and contaminated areas
- Proper patient isolation
- Post-exposure prophylaxis
- Treatment
- Control/screening of visitors
- Immunization of HCWs
- Internal communications
- Availability of diagnostic tests
- Availability of PPE
DEVELOPING A BT PLAN

- Have a written BT preparedness plan
- Assess the feasibility and viability of the plan
- Disseminate the plan and ensure familiarity by all key stakeholders
- Use elements of daily practice as the backbone of the plan
- Incorporate internal mechanisms for intensified surveillance
- Ensure appropriate internal and external mechanisms of communication
- Test the plan periodically through drills
- Incorporate flexibility and build redundancy for key components
- Address logistics involving surge capacity
- Emphasize community preparedness

Shaikh Z. ID Clinics NA 2006;20:433-453
AN APPROACH TO BT PREPAREDNESS

- What is the external threat landscape? (Who/When)
  - State/non-state/lone wolves; covert vs overt; new biotech (gene editing)

- What is possible? What is feasible or likely? (What)
  - Bacteria, viruses, toxins
  - Combined attack - all hazards (chem/bio/rad/nuclear/cyber)

- What are routes of transmission & spread? (How/Where)
  - Respiratory, food/water, mail, bomb, what else?
  - Public places, transit hubs, restaurants, what else?

- What is the intended impact & gain? (Why)
  - Mass impact vs mass casualties
THE MISSION:
4 EYES FOR BIOTHREATS

- IDENTIFY
  - Clinicians & microbiologists

- ISOLATE
  - Clinicians, infection control, hospital admin

- INFORM
  - Clinicians/labs to public health authorities, government, media

- INVESTIGATE
  - Police, internal security, governments, international agencies
WE HAVE A DUTY TO BE PREPARED

2011, NYC, Attack by hijacked planes

1995, Tokyo, Attack subways with Sarin by Aum Shinriko cult
THANK YOU!!